THE ADDITIVE VERSUS THE BORROWING METHOD OF SUBTRACTION

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In the November, 1919, *Elementary School Journal* appeared an article by Joseph S. Taylor, District Superintendent of Schools, New York City, setting forth the results of a survey conducted by him into the results of additive subtraction teaching in the New York schools. Briefly, Mr. Taylor presented the following: Beginning with the school year 1912-13, the New York City schools determined upon the teaching of subtraction exclusively by the Austrian or additive method. During the spring of 1919, a survey was made of the results in districts one and seven. Children of the fourth, fifth, and sixth grades (those who presumably have never been taught anything but additive subtraction) were requested to tell the method which they followed in performing the simple subtraction, $\begin{array}{r} 61 \\ -29 \end{array}$. Three questions were asked:

a) How many say: 9 from 11 = 2; 2 from 5 = 3?
b) How many say: 9 from 11 = 2; 3 from 6 = 3?
c) How many say: 9 and 2 are 11; 3 and 3 are 6?

TABLE I

Method	Number of Children	Percentage
a	2,483	21.8
b	4,625	40.6
c	4,260	37.6

A summary of the results is given in Table I. It is seen that less than half of the children are using the additive method. Summarized by grades, the facts appear as shown in Table II. This proves, Mr. Taylor concludes, that "by the time the children reach the sixth grade, seventy-eight out of every one hundred subtract by a method which is officially excluded from the schools." Mr. Taylor further points out that, theoretically, the desirability

of the additive method is subject to discussion, and by no means a proved case.

Despite the force of Mr. Taylor's figures, it is still possible to question the conclusions which he draws. It is fair to assume that, in spite of the fact that the Austrian was the prescribed method, a large number of teachers may have persisted in following earlier methods of instruction. The increasing proportion of additive-process cases found in the lower grades might indicate that the irreconcilables were being replaced by new blood more favorable to the newer method, or that closer supervision was forcing observance of the additive method.

As nothing is to be gained by argument, an interesting experiment is presented instead. The elementary department of the

TABLE II

Grade	Per Cent Using		
	Method a	Method b	Method c
IV	13.9	33.4	52.7
V	22.4	41.2	36.4
VI	31.6	47.2	21.2

San Francisco Normal School has been teaching subtraction by the additive method for sixteen years. This has also been the method of the California state text for nine years, and presumably has been taught in the San Francisco schools during that time. The children of the grammar grades of the elementary department have been taught subtraction in one or the other of these places. A survey of the sixth, seventh, and eighth grades, similar to that made by Mr. Taylor, should shed some interesting light on the question of additive subtraction.

The same problem used by Mr. Taylor was presented for oral subtraction. The results appear in Table III.

With the data positively in hand—that is, figuring purely upon the 83 cases taught and tested in the San Francisco Normal School—51.8 per cent of the children have in four or five years abandoned the additive and adopted the borrowing method. Of the San Francisco public-school products, where of course we have no

means of knowing exactly how subtraction was taught, more than 78 per cent of the children are using the borrowing method.

An interesting question now presents itself, which is of course not new, and that is the relative efficiency of the two methods. To determine this the Courtis Standard Test—Series B in subtraction was given, with the results presented in Table IV.

TABLE III

	Total	Additive	Borrowing	Early Italian	Mixed
Pupils taught at San Francisco Normal School	83	40	43	.....	.....
Pupils taught in San Francisco schools	92	14	72	1	5
Total	175	54	115	1	5

Summarizing briefly Table IV, the pupils using the additive method are shown to be more accurate, by a considerable amount, but

TABLE IV

Method	Number of Pupils	Percentage with 100 per cent Accuracy	Percentage Missing One Problem or Less	Percentage above Courtis Sixth-Grade Standard	Median Rate	Median Accuracy
Additive	52	35.0	63.4	21.0	8.2	81.7
Borrowing	123	19.5	51.2	28.4	9.2	79.3

somewhat slower than the borrowing-method pupils. This slowness is shown by the median number of problems attempted, and again by the percentage of pupils exceeding the Courtis sixth-grade standards.

The conclusion to be drawn from the foregoing facts is that the prescription of one method only for teaching subtraction is certainly not justified by the evidence. That the preferable method of teaching subtraction is the additive method is certainly shown to be open to question. While the advantage in point of accuracy seems to be with those who have retained the additive method, the question arises: If those using the borrowing method were able to do more rapid work with a means which they adopted in spite of their instruction, what would they have been able to do had they been trained from the beginning in the method which they unquestionably prefer?